

United States Environmental Protection Agency Washington, DC 20460				Work Assignment Number: 1-24 <input checked="" type="radio"/> Original <input type="radio"/> Amendment				
Work Assignment								
Contract Number: EP-C-09-027		Contract Period 04/01/2010 - 03/31/2011		SF Site Name:				
		Option Period No. 1						
Title of Work Assignment: Improving EPA's CUE Cost Model								
Suggested Source: Arcadis				Specify Section & Paragraph of Contract SOW:				
Purpose: <input checked="" type="radio"/> Work Assignment Initiation <input type="radio"/> Work Assignment Close-Out <input type="radio"/> Work Assignment Amendment <input type="radio"/> Incremental Funding <input type="radio"/> Work Plan Approval				Period of Performance From: 04/12/2010 To: 03/31/2010				
Comments:				CA Category (check one) <input type="radio"/> I Enforcement <input type="radio"/> II Standard Setting <input type="radio"/> III Technology Development <input checked="" type="radio"/> IV Proof of Concept <input type="radio"/> N/A				
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.								
SFO 22 <input type="checkbox"/> Superfund (Max 2)		Accounting and Appropriations Data						
		<input type="checkbox"/> Non-Superfund						
DCN (Max 6)	Budget/FYs (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount	Sites/Project (Max 8)	Cost Org/Code (Max 7)
1								
2								
3								
4								
5								
Authorized Work Assignment Ceiling								
Contract Period:		Cost/Fee				LOE		
Previously Approved		New				0		
This Action						0		
Total						0		
Work Plan / Cost Estimate Approvals								
Contractor WP Dated:		Cost/Fee:				LOE:		
Cumulative Approved:		Cost/Fee:				LOE:		
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Project Officer Name: DIANE L. PIERCE		Branch/Mail Code: TSB		Phone Number: (919) 541-2703				
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Contractor Acknowledgement				Receipt and Approval of Workplan (Signature and Title)		Date		

**Statement of Work
For
WA 1-24
Improving EPA's CUECost Model**

Coal Utility Environmental Cost (CUECost) is an engineering economic decision support tool developed by the EPA which can be used for estimating the cost of air pollution controls on coal-fired utility boilers. CUECost is an Excel based tool, which provides budgetary rough-order-of-magnitude (ROM) or "desktop" engineering cost estimates for installing additional pollution controls on existing pulverized coal-fired power plant boilers, larger than 100MW in size. The current version of CUECost includes an array of combustion modification and end-of-pipe control technologies for reducing SO₂, NO_x, PM, and mercury (Hg) emissions. Recent upgrades to CUECost have built "learning-by-doing" or endogenous technological learning into the model to enable analysts to capture the impact of learning on the future cost of controls. Various utility boiler specific parameters such as firing type, boiler size, existing controls, and coal-type can be specified to estimate retrofit cost of controls for a particular boiler. Policy makers, analysts and energy modelers can use it to analyze cost-effectiveness of various options to install air pollution control equipment on existing utility boilers.

The latest version of the CUECost (version 5.0) expands the model's previous capabilities to include advanced coal-fired power generation technologies such as supercritical and ultra-supercritical boilers, oxy-fuel combustion, integrated gasification combined cycle (IGCC) plants, and end-of-pipe CO₂ capture technologies such as the amine process. The User's Manual accompanying CUECost has also been updated to reflect these changes.

This project will gather data needed to improve the representation of CO₂ control options in the CUECost workbook. Specifically, the project will update data for CO₂ control technologies currently available and calibrate cost algorithms in accordance with the most recent available industry information.

Task 1: The contractor shall, in consultation with the WAM, obtain appropriate information and data from academic, government, and industry sources (publications, models, etc.) needed to characterize current availability, installation/retrofit potential, costs, and performance of CO₂ control options currently available in the CUECost workbook. This shall include information for not only the post-combustion technologies such as amine and ammonia scrubbing, but also the various coal-fired power generation technologies such as supercritical steam and IGCC.

EPA currently is conducting a number of various efforts aimed at assembling information that may be applicable to this task. Therefore the contractor, in collaboration with the WAM, shall arrange a meeting with other EPA personnel to discuss current data

gathering efforts and how they may be of use in satisfying this task. This will insure that EPA research efforts are not duplicated and available resources are best allocated.

Deliverable: The contractor shall submit an interim technical memorandum containing a list of references and data sources, preliminary data obtained, and a description of the proposed approach to performing Task 2. This memorandum shall be provided to EPA for review and approval by July 15, 2010, and prior to initiation of Task 2.

Task 2: Upon EPA approval of the approach outlined in Task 1, the contractor shall incorporate the information obtained into the CUECost workbook. This will include updating necessary data for accurate (state-of-the-art) representation of existing CUECost CO₂ control options, as well as calibration of accompanying cost algorithms in accordance with the most recent available data sources. Successful calibration will be achieved when returned values are within +/- 30% (ROM) of those predicted by other the identified sources.

This work shall be performed preferably by an individual(s) familiar with both the CUECost workbook and the process for performing calibration of such tools. Information supporting the qualifications of subject personnel should be included in the Task 1 deliverable.

Deliverable: The contractor shall document all work performed in a technical memorandum, provided to EPA along with an updated version of the CUECost workbook by October 31, 2010.

Note: Optional tasks for updating the CUECost workbook documentation and developing reports and/or presentations relative to the nature of CO₂ control options and cost may be exercised upon completion of these tasks. The EPA WAM will discuss the potential for pursuing these options with the contractor following completion of Task 1.

Quality Assurance

The contractor shall perform the activities described in the above mentioned tasks in accordance with the QAPP entitled "Improving EPA's CUECost Model", dated 3/11/2008. If the scope of work has changed significantly from that described in the

Contract
EPC-04-023-ARCADIS Work Assignment 4-25, the contractor shall revise the QAPP and work involving environmental data shall not commence until it has received official approval from the EPA Quality Assurance Staff. The contractor shall comply with all requirements as delineated on the "Quality Assurance Review Form" included with this extramural action.

ATTACHMENT #1 TO THE STATEMENT OF WORK (SOW) FOR RESEARCH MODEL DEVELOPMENT AND APPLICATION PROJECTS

NRMRL Quality Assurance (QA) Requirements

In accordance with EPA Order 5360.1 A2, conformance to ANSI/ASQC E4 must be demonstrated by submitting the quality documentation specified herein. All quality documentation shall be submitted to the Government for review. The Government will review and return the quality documentation, with comments, and indicate approval or disapproval. If the quality documentation is not approved, it must be revised to address all comments and shall be resubmitted to the Government for approval. Work involving environmental data collection, generation, use, or reporting shall not commence until the Government has approved the quality documentation. The quality documentation shall be submitted to the Government at least thirty (30) days prior to the beginning of any environmental data gathering or generation activity in order to allow sufficient time for review and revisions to be completed. After the Government has approved the quality documentation, the Contractor shall also implement it as written and approved by the Government. Any EPA-funded project/program may be subject to a QA audit.

TO BE SUBMITTED PRE-AWARD (mark all that apply):

☐ **NRMRL's Quality System Specifications:**

- (1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;
- (2) an organizational chart showing the position of the QA function;
- (3) delineation of the authority and responsibilities of the QA function;
- (4) the background and experience of the QA personnel who will be assigned to the project; and
- (5) the organization's general approach for accomplishing the QA specifications in the SOW.

- ☐ **Quality Management Plan:** prepared in accordance with R-2 - EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001,
<http://www.epa.gov/quality/qs-docs/r2-final.pdf>

TO BE SUBMITTED POST-AWARD (mark all that apply):

☐ **NRMRL's Quality System Specifications:**

- (1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;
- (2) an organizational chart showing the position of the QA function; 07/14/08 A-2
- (3) delineation of the authority and responsibilities of the QA function;
- (4) the background and experience of the QA personnel who will be assigned to the project; and
- (5) the organization's general approach for accomplishing the QA specifications in the SOW.

- ☐ **Quality Management Plan:** prepared in accordance with R-2 - EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001,
<http://www.epa.gov/quality/qs-docs/r2-final.pdf>

- ☐ **Category I or II Quality Assurance Project Plan (QAPP):** prepared in accordance with R-5 - EPA Requirements for QA Project Plans (EPA/240/B-01/003) March, 2001
<http://www.epa.gov/quality/qs-docs/r5-final.pdf>

- X Category III or IV QAPP:** prepared in accordance with applicable sections of the following NRMRL QAPP Requirements List(s) which is(are) included in this attachment:

- QAPP Requirements for Measurement Projects
- QAPP Requirements for Secondary Data Projects
- X QAPP Requirements for Research Model Development and/or Application Projects
- QAPP Requirements for Software Development Projects
- QAPP Requirements for Method Development Projects
- QAPP Requirements for Design, Construction, and/or Operation of Environmental Technology Projects

ADDITIONAL QA RESOURCES:

EPA's Quality System Website: <http://www.epa.gov/quality/>

EPA's Requirements and Guidance Documents: http://www.epa.gov/quality/qa_docs.html

NRMRL QAPP REQUIREMENTS FOR RESEARCH MODEL DEVELOPMENT AND APPLICATION PROJECTS

GENERAL REQUIREMENTS:

Include cover page, distribution list, approvals, and page numbers.

0. COVER PAGE

Include the Division/Branch, project title, revision number, EPA technical lead, QA category, organization responsible for QAPP preparation, and date.

1. PROJECT DESCRIPTION AND OBJECTIVES (MODEL DEVELOPMENT AND MODEL APPLICATION)

In this document, "project" can mean (a) development or substantial modification of a model for application to address a general problem; (b) application of an existing model (including minor modification to the existing model) to address a specific problem; or (c) a development or substantial modification and application of a model to address a specific problem.

- 1.1 State the purpose of the project and list the project objective(s). Indicate whether a new model will be developed or an existing model will be used.
- 1.2 Describe the problem, the data to be generated by the model, how the data will be used to address the problem, and the intended users of the data. Describe the environmental system/setting to be modeled, where the model will be applied, and the circumstances and scenarios to be considered for the modeled system.

2. ORGANIZATION AND RESPONSIBILITIES (MODEL DEVELOPMENT AND MODEL APPLICATION)

- 2.1 Identify all project personnel, including QA, and related responsibilities for each participating organization, as well as their relationship to other project participants.
- 2.2 Include a project schedule that includes key milestones.

3. MODEL SELECTION (MODEL APPLICATION ONLY)

- 3.1 Discuss model selection with respect to how it will be used and how it is consistent with the project objectives. Include fundamental details such as whether the model will be used to predict the world beyond the model or in scenario analysis of the model itself. Describe the limits to where the model is applicable.
- 3.2 Provide a description of the model attributes/capabilities required for the project. This description should include hardware requirements and restrictions. Provide an overview of the candidate model attributes, including:
 - model origin and its original purpose, if applicable
 - model structure (e.g., stochastic vs. deterministic, structural framework)
 - parameters and variables
 - the algorithms and equations that have been developed to support the model theory, along with the sources of the algorithms
 - spatial extent (individual, group, population)
 - spatial resolution (location independent/dependent, dimensionality)
 - temporal extent (length of modeling period)
 - temporal resolution (time step)
- 3.3 Identify the model to be used or, if the model has not yet been selected, describe the process to be used for the selection of an existing model.
- 3.4 Identify specific requirements for application of the selected model for this specific purpose (e.g., current and appropriate data, parameter values, assumptions).

4. MODEL DESIGN (MODEL DEVELOPMENT ONLY)

- 4.1 Describe the conceptual model(s) for the system, including model parameters.
- 4.2 Identify algorithms and equations that have been developed to support the model theory, or if such equations are not already available, describe the process used to develop these equations.
- 4.3 Specify required sources for model databases and any requirements for these data (e.g., quality, quantity, spatial, and temporal applicability). If data sources are not currently known, describe the criteria used to identify sources. Describe how any data gaps will be filled.

5. MODEL CODING (MODEL DEVELOPMENT ONLY)

- 5.1 Discuss the requirements for model code development, where applicable.
- 5.2 Identify computer hardware and software requirements.
- 5.3 Discuss requirements for code verification.

6. MODEL CALIBRATION (MODEL DEVELOPMENT AND MODEL APPLICATION)

Calibration is the process of adjusting model parameters within physically defensible ranges until the resulting predictions give the best possible or desired degree of fit to the observed data. Calibration should be applied each time the model is modified.

- 6.1 Discuss how the model will be calibrated.
- 6.2 Identify the type and source of data (e.g., new data, existing data, professional judgment, expert opinion elicitation) that will be used to calibrate the model, including any requirements for the data (quality, quantity, and spatial and temporal applicability). If data sources are not currently known, describe the criteria used to identify sources.
- 6.3 Specify acceptance criteria which need to be met for the difference between predicted and observed data during model calibration, where applicable. The statistical methods (e.g., goodness-of-fit, regression analyses) or expert judgment to be used should also be discussed.

7. MODEL VERIFICATION (MODEL DEVELOPMENT AND MODEL APPLICATION)

Verification consists of comparing the predictions of a calibrated model with available data that were not used in the model development and calibration.

- 7.1 Discuss the approach to be used for model verification. Describe how the verification is appropriate based on the model's purpose. Identify the type and source of data (e.g., new data, existing data, synthetic test data sets, professional judgment, expert opinion elicitation) that will be used to verify the model. If data sources are not currently known, describe the criteria used to identify sources.
- 7.2 Discuss the characterization of model uncertainty (model framework, model input, and model applicability) and sensitivity (model application only).
- 7.3 Describe any requirements (quality, quantity, and spatial and temporal applicability) for the data that will be used to verify the model.
- 7.4 Describe the approach used to determine if the independent data verify the model predictions. Specify the criteria which need to be met for the difference between predicted and observed data for the model to be considered to be verified. Discuss any statistical methods to be used (e.g., goodness-of-fit, regression analyses).

8. MODEL EVALUATION (MODEL DEVELOPMENT AND MODEL APPLICATION)

- 8.1 List and describe the qualitative or quantitative assessment process to be used to generate information to determine whether a model and its analytical results are of a quality sufficient for the intended use.
- 8.2 List and describe any independent/external evaluation and review of the model and model design, such as scientific peer review.

9. MODEL DOCUMENTATION (MODEL DEVELOPMENT AND MODEL APPLICATION)

Specify the requirements for model documentation. Good documentation includes:

- final model description, final model specifications (model development only), hardware and software requirements, including programming language, model portability, memory requirements, required hardware/software for application, data standards for information storage and retrieval
- the equations on which the model is based (model development only)
- the underlying assumptions
- flow charts (model development only)
- description of routines (model development only)
- data base description
- source code (model development only)
- error messages (model development only)
- parameter values and sources
- restrictions on model application, including assumptions, parameter values and sources, boundary and initial conditions, validation/calibration of the model, output and interpretation of model runs (model development only)
- the boundary conditions used in the model
- limiting conditions on model applications, detail where the model is or is not suited
- changes and verification of changes made in code
- actual input data (type and format) used
- overview of the immediate (non-manipulated or -post processed) results of the model runs (model application only)
- output of model runs and interpretation
- user's guide (electronic or paper)
- instructions for preparing data files (model development only)
- example problems complete with input and output
- programmer's instructions
- computer operator's instructions

- a report of the model calibration, validation, and evaluation (model development only)
- documentation of significant changes to the model
- procedures for maintenance and user support, if applicable

10. REPORTING (MODEL DEVELOPMENT AND MODEL APPLICATION)

10.1 List and describe the deliverables expected from each project participant.

10.2 Specify the expected final product(s) that will be prepared for the project (e.g., journal article, final report).

11. REFERENCES

Provide the references either in the body of the text as footnotes or in a separate section.